APPLICATION FOR UNITED STATES LETTERS PATENT

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**Connector for Shielded Cable Assembly**

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# CONNECTOR FOR SHIELDED CABLE ASSEMBLY

## BACKGROUND

[1] In the Local-Area-Networking (LAN) industry, Unshielded-Twisted-Pair (UTP) cables are predominant. UTP cables are used because the twisting provides high immunity to electromagnetic interference (EMI) and electromagnetic compatibility (EMC). Further, because they are unshielded, UTP cables provide isolation between stations that might have unequal ground potentials and thus prevent ground loops between such stations.

[2] For 10-Gigabit-Ethernet-on-UTP solutions being considered by the IEEE, there is a problem associated with UTP that may limit feasibility and increase cost of the silicon being considered. This problem is typically referred to as Alien-Near-End Crosstalk (ANEXT) which is noise/interference that comes from electrical signals on adjacent UTP cables and typically cannot be eliminated by a transceiver using correlated noise cancellation circuits.

[3] In addition, Near-End Crosstalk (NEXT) caused by adjacent transmitters also causes interference, but is typically less of a problem as associated electrical signals are correlated to a reference source that a transceiver can use to cancel much of the interference.

[4] There are types of shielded cables that would substantially reduce the effects of this interference, but because the shielding is connected to ground at both ends of a cable, these cables may generate ground loops.

[5] A ground loop exists when two pieces of equipment, which are on different power circuits and are referenced to different ground potentials, are connected together with a cable having a shield that connects the equipment shields' grounds together with low DC impedance.

[6] Because of this problem with ground loops, the US LAN industry has traditionally supported UTP. In Europe, where Shielded-Twisted-Pair (STP) cables are more common, extensive management of power grids (to maintain equal ground potential from one location to another) is typically required to suppress ground looping. Europe has also adopted a 100-ohm UTP look-alike cable that contains a

light foil shield (FTP) and that utilizes a common RJ-45 connector and is field terminable. However, because it is shielded, the UTP look-alike cable typically has the same problems as STP cables with respect to ground loops.

**[7]** Referring to **FIGS. 1** and **2**, a conventional shielded modular plug ***10*** for terminating a shielded multi-pair communication cable ***14*** is illustrated. Cable **14** comprises an insulating sheath ***16*** enclosing a conductive cable shield ***15*** that, in turn, encloses four pairs of conductors or wires ***18***, each wire pair or signal pair twisted together (not shown) and forming a respective signal path during use. The construction of plug ***10*** is well known and generally comprises a dielectric housing ***19*** having a closed forward free end ***22***, a cable-receiving rearward end ***24***, a terminal receiving side ***26*** and a cable-receiving cavity (not shown) extending longitudinally from the rearward end ***24*** of the housing ***19*** to the terminal receiving side ***26***.

**[8]** The plug ***10*** further includes a conductive shield portion **20** that electrically contacts the cable shield ***15*** when, as seen in **FIG. 2**, the plug ***10*** receives the cable ***14***. Eight parallel slots ***28*** defined by corresponding fins ***29*** open on to the terminal-receiving side ***26*** of housing ***19*** for receiving flat contact terminals ***30***. The eight slots ***28*** are aligned over a planar array of respective longitudinally extending wire-receiving parallel passages (not shown) which communicate with the cable-receiving cavity and which receive the ends of respective cable wires ***18***. Each flat contact terminal ***30*** is inserted into and fixed within an associated terminal-receiving slot ***28*** to terminate a respective wire ***18*** located in a respective wire-receiving passage.

## SUMMARY

**[9]** According to an embodiment of the present invention, a cable connector assembly for receiving a shielded cable assembly comprises a conductive connector shield and an impedance operable to couple the connector shield to a shield of the shielded cable assembly.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[10]** **FIG. 1** is a perspective view of a conventional modular plug and multi-pair cable prior to termination according to the prior art;

**[11]** **FIG. 2** is a top partial-cutaway view of the conventional modular plug and multi-pair cable of **FIG. 1** in terminal combination;

**[12]** **FIG. 3** is a top partial-cutaway view of a modular plug and multi-pair cable in combination according to an embodiment of the present invention; and

**[13]** **FIG. 4** is a schematic diagram of an electronic system according to an embodiment of the present invention.

## DETAILED DESCRIPTION

**[14]** **FIG. 3** illustrates a combination of the shielded multi-pair communication cable ***14*** of **FIG. 2** and a shielded modular plug ***40*** according to an embodiment of the present invention. As is the case with the prior-art plug-cable combination illustrated in **FIGS. 1** and **2**, the plug ***40*** includes contact terminals ***30*** that terminate respective wires ***18*** associated with the cable ***14***. As can be seen in **FIG. 3**, the plug ***40*** similarly has disposed thereon a conductive shield portion ***50*** that is arranged on a dielectric housing ***55*** such that the conductive shield portion ***50*** does not contact the cable shield ***15*** when the cable ***14*** mates with the plug ***40***. Disposed within the housing ***55*** and contacting the cable shield ***15*** is a conductive element ***60*** which, in one embodiment, is annular. In alternative embodiments, the conductive element ***60*** may be of any other shape or configuration suitable for providing an electrical contact with the cable shield. For example, the element ***60*** may comprise multiple conductive portions.

**[15]** Attached to the conductive element ***60*** by respective contact terminals ***62*** and ***64*** are a capacitor ***70*** and a resistor **80**. The capacitor **70** and the resistor ***80*** also contact the shield portion ***50*** by terminals ***82*** and ***84***, respectively. As such, the capacitor ***70*** and resistor ***80*** are positioned electrically in parallel between the cable shield ***15*** and the shield portion ***50***. In one embodiment, the capacitor ***70*** and resistor ***80*** are embedded in the housing ***55***, the capacitor ***70*** has a value C of approximately 0.01 μF, and the resistor has a value R of approximately 2 MΩ. The contact terminals ***62, 82, 64, 84*** are, in one embodiment, made from an elastic conductive material, such as stainless steel, so as to allow relative movement

between the shield portion ***50*** and conductive element ***60*** without compromising contact with each.

**[16]** In operation, the resistor ***80*** enables a relatively small discharge current to flow between the cable shield ***15*** and ground (via the shield portion ***50***) when the plug ***40*** is coupled to an electronic device, such as a computer (not shown). Such a small discharge current prevents static-charge buildup on the cable shield ***15***. Moreover, by positioning the capacitor ***70*** between the cable shield ***15*** and ground, a low-AC impedance connection is created thereby allowing the shield ***15*** to provide optimal shielding from EMI and EMC. Put another way, the resistor ***80*** limits to a safe level a DC current that flows between two grounds (at the ends of the cable ***14***) that are at unequal potentials, but the capacitor ***70*** grounds the shield **15** for AC signals, particularly for signals that contain AC frequencies that may cause interference.

**[17]** In an alternative embodiment illustrated in **FIG. 3** that excludes the capacitor ***70***, a capacitance ***85*** is formed from a combination of the conductive element ***60*** and a flange ***86*** (shown in broken lines) of the shield portion ***50***. That is, the element ***60*** and flange ***86*** form respective plates of a capacitor having a capacitance ***85***. The region between these plates may be filled with air or another dielectric, as is known. The capacitance ***85*** functions in a manner similar to that described above in connection with the capacitor ***70***.

**[18]** **FIG. 4** illustrates an electronic system ***87*** according to an embodiment of the present invention. The electronic system ***87*** may, for example, be a LAN, or any other system utilizing electrical signals. The electronic system ***87*** comprises devices ***90*** and ***91*** that communicate via a transmission medium ***95***, which includes the cable ***14*** and plugs ***40*** and ***40'***. At least the device ***90*** includes a processor ***92***, and the devices ***90*** and ***91*** may be, *e.g.*, personal computers or computer workstations, testing devices, or set-top boxes configured to deliver media to a display device. Alternatively, the device ***90*** may be an oscilloscope, in which case the device ***91*** may be a probe assembly as known in the art.

**[19]** The electronic system ***87*** further comprises the signal-transmission medium ***95*** coupled to the devices ***90*** and ***91*** as described above. The signal-

transmission medium ***95*** comprises the combination of the cable ***14*** with, at one end of the cable ***14***, the plug ***40*** illustrated in and discussed with reference to **FIG. 3**, and, at the other end of the cable ***14***, a plug ***40'*** similar to the plug ***40***.

**[20]** By employing the plugs ***40*** and ***40'***, the electronic system ***87*** is minimally susceptible to problems associated with ground loops. For example, suppose, as illustrated in **FIG. 4**, the difference in ground potential between devices ***90*** and ***91*** is 2V and the resistance of the cable ***14*** is negligible. Because the resistor ***80*** of the plug ***40*** has, in an embodiment described above, a resistance of 2MΩ, and the sum of the resistors from plug ***40*** and ***40'*** is 4MΩ, the DC current in the cable ***14***, when joined with both devices ***90*** and ***91***, is a mere .5μA.

**[21]** The preceding discussion is presented to enable a person skilled in the art to make and use the invention. Various modifications to the disclosed embodiments will be readily apparent to those skilled in the art, and the generic principles herein may be applied to other embodiments and applications without departing from the spirit and scope of the present invention. Thus, the present invention is not intended to be limited to the embodiments shown, but is to be accorded the widest scope consistent with the principles and features disclosed herein.